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ABSTRACT

Education continues to move on-line through the World Wide Web. Classrooms of students and teachers are no longer restricted by time or distance. ClassNet is a tool that manages these virtual classrooms; it automates many of the administrative tasks associated with global Internet classes. Through a simple interface of Web forms, students can perform activities such as class registration, assignment or test submission, and grade retrieval. Instructor activities include managing assignments, controlling class enrollment, communicating with students, and monitoring student progress. This paper highlights features of ClassNet's design and functionality and provides examples of its use. Topics discussed include: ClassNet design, underlying objects, and their functionality; requests and classes; assignments; class members--instructors, students, and proctors; organization of the ClassNet database; current uses at Iowa State University; and features and futures. (Author/DLS)

ClassNet: Managing the Virtual Classroom

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Abstract: Education continues to move on-line through the World Wide Web. Classrooms of students and teachers are no longer restricted by time or distance. ClassNet (http://classnet.cc.iastate.edu/) is a tool which manages these virtual classrooms: It automates many of the administrative tasks associated with global Internet classes. Through a simple interface of Web forms, students can perform activities such as class registration, assignment or test submission, and grade retrieval. Meanwhile, instructor activities include managing assignments, controlling class enrollment, communicating with students, and monitoring student progress. This article highlights features of ClassNet's design and functionality and provides examples of its use.

Introduction

Virtual classrooms, virtual degrees, and virtual universities are actually explicit realities in today's educational community. Authors such as [Barker 1994] note that we are now educating geographically diverse populations and that "virtual [classrooms] will become as commonplace in higher education as the chalkboard once was" [p. 159]. One only needs to visit either the World Lecture Hall at the University of Texas at Austin (http://www.utexas.edu/world/instruction/index.html) or the Open University in England (http://www.open.ac.uk) to find concrete examples of this educational phenomenon [Shotsberger 1996]. Further, well designed activities via the Web can offer students a valuable learner-centered education [Stout & Thompson 1995].

However, how are these distance-oriented classrooms managed? Who or what handles details such as the registration, grades, assignments, portfolios, and tests? Some have used e-mail for handling a few of these details [Pitt 1996; Poling 1994; Wei He & Knapp 1995]. Others have programmers developing CGI-Scripts specifically for their classes [Dix, Allendoerfer, Jones, Lacey & Laurenzi 1995]. These scripts handle the student information (originating from a browser interface) and may or may not store the information centrally. Unfortunately, not all instructors involved in distance education have access to a programmer, some CGI-scripts already developed are too specific for use across a wide array of classes, and e-mail presents disk space and organizational problems [Wei He & Knapp 1995].

ClassNet (http://classnet.cc.iastate.edu/) is a general solution to this problem: Its purpose is to bring automated administrative functionality to global Internet classes. Classrooms and their management details are handled by a tool that organizes the diverse information needed to administer these classes. Students and teachers interact with this tool through a simple Web interface and thus only need access to a browser of their choice. Although ClassNet's purpose is not unique (http://west.ucd.ie/), many aspects of its design and functionality are.

ClassNet Design, Underlying Objects, and Their Functionality

ClassNet is a CGI-Script running underneath a UNIX HTTP server. The alpha release (January, 1996) is written in C++, but the future beta release (scheduled for August, 1996) will consist of Perl5 modules. Users interact with ClassNet through simple HTML forms which are not browser specific. ClassNet, in turn, acts as the gateway between a database of registered classes and the users.

ClassNet consists primarily of four objects: requests, classes, assignments, and class members. Each object provides necessary functionality for ClassNet's operation. Considering the myriad of responsibilities in classroom management (e.g. student drops and adds, assignment due dates, assignment corrections, grades, security, etc.), each object becomes rather complex in its own unique way. Abstract descriptions and portions of their responsibilities are given below.

Requests and Classes

The request object is the first object created when the HTTP server calls ClassNet. Its responsibility is to create an array of name/value pairs contained in the incoming HTML form. Forms are generally required to have four field names for identification purposes: username, password, class, and page name. The page name contains a value which identifies the user's request to ClassNet.

Essential duties of a class object are to check for class membership, to permit student registration, and to create and remove classes from the database. Anyone in the world can enroll for a class registered with ClassNet. Consequently, the class object keeps track of students requesting enrollment and generates an HTML form consisting of checkboxes and student names when requested by the instructor. All checked students are then enrolled in the class while any spurious requests are removed. Thus, the instructor has complete control of the enrollment process merely through a point and click interface.

Assignments

Assignments (tests and quizzes included) are HTML forms created by the instructor and are handled by the assignment object in ClassNet. These forms are stored in the instructor's Web directory and thus are not stored in ClassNet's database. To aid the instructor in the assignment construction process, an interactive cut and paste mechanism is currently employed: An instructor enters a question through a ClassNet form, and ClassNet sends back the HTML version of that question which can then be pasted into a growing HTML document on the instructor's end. This mechanism is being updated for the beta release of ClassNet: Instructors will be allowed to construct multiple versions of the same question, and they will be sent the entire form upon completion instead of one question at a time. Multiple versions of the same question will allow for automatic random generation of test/quiz questions to each student in an entire class.

Three question types are recognized by an assignment object -- multiple-choice, short-answer, and essay. Fill-in-the-bank questions are a type of short-answer, and true/false questions are a type of multiple-choice. Automated grading is permitted for multiple-choice and short-answer questions as both the instructor and student answers are stored in ClassNet's database. Currently, tests containing essay questions are e-mailed to a designated recipient for further grading and comments on the essays. Essay answers are not stored in the database but will be in the beta release.

When the instructor submits an assignment form, ClassNet recognizes this as an answer key. Subsequently, another form is returned to the instructor requesting information such as the due-date, the permission for students to view the answer key after the due-date, the partial and total points for each question, the answer range for numeric short-answer questions, and the requirements for grading short-answer string answers (e.g. enforce capitalization or spelling). This information is compactly stored along with the answer key in the database.

Because assignment answers for both the teacher and the student are stored in the database, students can receive immediate feedback on how they performed, while instructors can easily view how individual students or an entire class are doing. Students asking ClassNet for a particular assignment will receive both their answers and the instructor's -- provided the due-date is past and the instructor has told

ClassNet that students may view the answers. Instructors may also enter grades for students on other assessed in-class activities. Thus, ClassNet is also an on-line grade book which students can access from any geographic location. Although the instructor has access to all students' assignments and grades, student usernames and passwords permit students to only view their own.

Class Members -- Instructors, Students, Proctors

Instructor objects have the least restrictions and the widest range of functionality in ClassNet. For example, instructor activities may include:

_ registering classes (with approval from ClassNet administrators);

_ approving student-initiated registrations;

_ adding, editing and deleting any class members;

_ adding, editing and deleting assignments and grades;

_ creating assignments;

_ communicating with students; and

_ viewing student grade reports or assignments.

The second, and most frequently used of the class member objects, are students. Students can register for a class, submit assignments for grading, see their grades, and view their own graded assignments and answers. The ability to view assignments and grades on-line will alleviate traffic to the instructor or teaching assistant. Student requests for class registration must be approved by the instructor.

Proctor objects allow individuals designated by the instructor to verify that the actual student submitted his or her quiz. Proctors receive a list (HTML form of checkboxes) of all students who submitted a particular quiz or test and check those students whom they monitored. Subsequently, the quiz or test of checked students are graded and possibly e-mailed for further grading of essay questions while unchecked student assignments are left ungraded. Answers to essay questions in the beta release will likely remain in the ClassNet database, and the instructor will interact directly with the database to grade those questions. An e-mailed version will be available as well.

Organization of the ClassNet Database

ClassNet's database is currently organized as UNIX directories and file structures. All classes are stored on a secure disk accessible only by ClassNet administrators, and backups are performed daily. A typical class layout is:

classname

/ | \

admin ASSIGNMENTS students

/ \ / ..... \

members REQUESTS student_1 student_n

/ \ / \ / \

STUDENTS TEACHERS GRADED UNGRADED GRADED UNGRADED

The bottom rows of directories, denoted by capital letters, contain the files needed for class management. The student and teacher directories contain individual class member files which hold five pieces of information: first name, last name, username, password, and e-mail address. The request directory contains those students requesting enrollment, and a student file is moved from this directory to the student directory when an instructor approves enrollment of that particular student. For security purposes, the request directory also contains an enrollment monitor that places a limit on the number of outstanding enrollment requests. The assignment directory contains all the HTML assignments for a class. These files hold only the name, answer, and grading specifications for each question. Security plays a role here as well: An incoming student assignment is checked against these files to see if it is indeed a valid assignment containing valid questions. An invalid incoming assignment is discarded and the student is notified. Lastly, the graded and ungraded directories contain each student's submitted graded and ungraded assignments.

Current Uses

Dr. Doug Yarger at Iowa State University has used ClassNet to manage daily weather forecasts of 250 students in a weather forecasting contest. Dr. Yarger's primary assignments are actually "forecast" forms which each student submits approximately 60 times per semester. He also uses ClassNet as an on-line grade book for additional in-class quizzes.

For the weather forecasting contest, students extract weather information from on-line products such as surface maps and satellite images and then submit forecasts for the following day. A forecast form asks students for 6 a.m. and noon temperatures, wind speed, wind direction, and precipitation, as well as explanations for their predictions. Because the forecast name contains a ClassNet reserved word delimited by @ symbols (e.g. DesMoines@NEXT_DATE@), it will be modified to a string representing the next day's date (e.g. DesMoines3_30_96). Consequently, one assignment form may be used for multiple assignments, and the students are bound to an explicit deadline of midnight.

Because Dr. Yarger's form consists only of multiple-choice and short-answer questions, ClassNet grades the entire student forecast automatically. If it contained essay questions, further human evaluation would be needed. When a student submits a forecast, ClassNet stores the student answers (provided the form has passed the validity check) and then grades all previously ungraded forecasts. It cannot grade the current forecast as the true answers cannot be identified until at least the next day. One of Dr. Yarger's teaching assistants later uses an identical form to enter the actual weather data obtained for a particular day.

ClassNet also allows a student to view any previously graded forecasts or assignments. A student first uses a ClassNet form to enter her or his username, password, class name, and request. If the request is to view assignments, ClassNet then sends back another form of radio buttons where he or she can select which assignment to view. After the student selects an assignment (or forecast) and re-submits the form, ClassNet responds by sending back an HTML document containing her or his answers for each question, the instructor's answer for each question, the points received and total points for each question, as well as the total points received and percentage correct for the assignment. If an assignment such as an in-class quiz were requested, ClassNet then sends back only a summary of the percentage correct and points received.

Another professor, Dr. William Gutowski, has been experimenting with ClassNet for on-line assignments. He constructs his own assignment forms through ClassNet's form construction mechanism.

Lastly, Mary Herring, a doctoral student and temporary instructor at Iowa State, is using ClassNet for a series of surveys. Her initial surveys consist entirely of essay questions, and her respondents subsequently answer these questions and submit the forms. ClassNet takes in the forms, formats the answers, and routes the answers on to the e-mail address designated by Mary. Her final surveys will be multiple-choice forms (Likert scale), and she may wish to either have these forms e-mailed to her or stored in ClassNet. In the beta release of ClassNet, we hope to incorporate item analysis which will help in analyzing or summarizing multiple-choice and short-answer surveys. Using forms in survey research answers some disadvantages listed by [Thach 1995] concerning the use of electronic mail surveys:

Forms through ClassNet can be set up to guarantee anonymity, and the layout of a Web form is generally much more inviting than an e-mailed questionnaire.

Features and Futures

ClassNet contains many features -- some of which were previously mentioned. These features, beneficial both to education and research, include:

_ global and device independent access where users are restricted neither to a geographic location nor to a particular hardware architecture or operating system;

_ easy classroom management integration with existing Web materials;

_ course-independent structure;

_ separation of course content from course management;

_ automated management helping instructors focus on teaching, not grading;

_ securely stored classroom management information (e.g. grades and assignments);

_ centralized accessibility to organized classroom data;

_ immediate and private access to individual assignments and grades;

_ capability to edit student grades and assignments or to automatically re-grade entire class assignments;

_ easy distribution and collection of surveys;

_ survey anonymity; and

_ free distribution.

Separation of course content from course management is a feature deserving special attention. This design decision was prompted by storage and efficiency concerns. Because ClassNet does not store Web pages, more storage is reserved for class registration. Additionally, instructors have total control of where their class content is stored and how it is delivered. ClassNet's efficiency is also enhanced: The server calling ClassNet must only respond to classroom management requests rather than both to management and content requests. A server handling requests such as viewing assignments, accessing and assigning grades, grading incoming and previous assignments, and communication with class members is a load in itself. Serving HTML pages of class content will burden the server further and unfortunately increase the "wait-time" of users. The management load presented by Dr. Yarger's one meteorology class of 250 students and additional teaching assistants has shown this to be an important design decision.

ClassNet is receiving a growing "wish list" for the future. Some of these requests are for additional options, while others are for new ways to improve existing options. Requests have included needs to:

_ provide additional support for inter-class communication;

_ store links to student Web page portfolios;

_ generate randomized test questions;

_ statistically analyze individual survey and test items;

_ calculate weighted grades and permit deletion of lowest scores;

_ store or route incoming data from Java simulations; and

_ further develop the assignment creation process.

These wishes are just a subset of a dynamically growing list: The ideas for future development are many.

Conclusion

The development of ClassNet has been an exciting and ongoing process of thinking how to improve education using the Internet. The use of the Web and CGI-Scripts have allowed distance education to become much more interactive. For example, the weather forecasting contest has recently been extended to other elementary, secondary, and post-secondary students and classes. This was not possible without the use of a tool such as ClassNet and required no modification of ClassNet's design. Our hope is that ClassNet will aid teachers in managing global or local classrooms as well as facilitate the learning process.

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